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A MEMORANDUM ON THE ACTIVATED SLUDGE PROCESS AT WARDS ISLAND, NEW YORK, SEWAGE TREATMENT PLANT, AND THE GUGGENHEIM PROCESS THERE AND AT ANDERSON, INDIANA

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A memorandum on the Activated Sludge Process at Wards Island, New York, Sewage Treatment Plant, and the Guggenheim Process there and at Anderson, Indiana. By James B. Lackey, Senior Biologist.

In the week of January 17-23, 1943, a biological investigation of the Wards Island Sewage Treatment Plant at New York was carried out. No biological investigation was made of the influent and the primary sedimentation basins, but aeration chambers and final effluent were studied, their flora and fauna listed and counts made of the numbers per ml. present.

At this time half the plant was being operated by the Guggenheim process, and half by routine activated sludge treatment. The primary work was to compare the numbers and kinds of organisms present in the two portions of the plant. Table I gives the composition of the flora and fauna.

Broadly speaking, the usual types of activated sludge organisms were present in both parts of the Wards Island Plant. In respect to total numbers present there was a scarcity of organisms due principally to the low counts of Vorticillidae; these stalked ciliates are usually more numerous in activated sludge than they were here. The species list for ciliates is also short; some other ciliate species are usually common in activated sludge.

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Amoeboid protozoa were likewise low in this plant, at least in respect to the larger forms.

Flagellate protozoa were about as usual, except that Poteriodendron and Monosiga have never before been found by the writer in such large numbers in any sewage treatment plant; Poteriodendron occurred in some abundance for a short time at the Columbus (Ohio) plant.

Specific comparisons are more interesting. Because of the iron dosage of Batteries C and D it was thought there might be wide differences in the biota of the two parts of the plant. No such difference was found except in numbers. It is not the purpose of this memorandum to consider the chemistry involved, but the percentage of suspended solids was much lower in C and D than in A and B, and this may account for some of the differences observed. On the other hand, it certainly cannot hold for the ten-fold difference in numbers of Aspidisca in A and B. Except for this difference in numbers all four batteries might be said to have an activated sludge group of ciliates. For the amoeboid protozoa, the conspicuous differences were the large numbers of the minute Hartmanella in C and D. As a rule very large numbers of these small amoebas indicate poor digestion in a tank.

There are also indications of differences to be seen from the list of flagellates. Bodo and Trepomonas are usually indicative of poor tank conditions - both are saprozoic and

both tolerate low oxygen or the presence of H_2S. Trepomonas is almost never found in activated sludge, but may be common to Imhoff tanks. The occurrence of Dinobryon in Battery D is noteworthy because it has never before been noted in a disposal plant.

Sphaerotilus occurred to some extent in all four batteries, but was almost abundant in C and D. There was some indication that one of the filamentous organisms in these two batteries was an atypical Sphaerotilus, but isolations gave only typical behaviour in the four tests run. There was, however, a very large amount of a very tenuous filament, non-branching, non-motile, and having a tendency to break into strands 50 or more micra in length. This also was isolated, and is apparently one of the rod forming bacteria, but not a spore-bearing, motile form.

The differences between the two halves of the plant are hardly indicative of a different flora and fauna for the two processes; the differences between C and D are probably due to the much lower solids content of the latter.

It was not believed that the two processes were close enough in amount of sewage treated, in iron dosages, and in other respects to provide the best comparison. Accordingly, the plant at Anderson, Indiana, was visited. This Guggenheim type plant has been in operation for about three years. Detailed examinations were made of material from all parts of the

plant and organisms in the mixed liquor are shown in Table I. It was found that there was a much smaller population in this plant than in the Wards Island Plant.

The reason for this was almost at once apparent: this plant frequently receives large "slugs" of industrial wastes, some of them highly toxic. During a two hour period the influent was red with blood from packing house wastes, and contained saprozoic organisms as Bodo, Trepomonas, Tetramitus, flagellates characteristic of a septic condition. A sample of influent containing chromium wastes was practically devoid of life, except for one fungus which seemed to grow well. The surprising thing about this plant is that it contains a fairly normal but small population, after the passage of such toxic materials. No Aspidisca were found in the Anderson tanks, but otherwise the ciliate population was comparable to that of activated sludge in species, while decidedly lower in numbers.

Amoeboid protozoa were almost lacking, only two species being present, and these in relatively small numbers. Flagellates were few in kinds and numbers, none of the saprozoic or anaerobic types being found, despite their numbers in the influent at times. Sphaerotilus was almost lacking in the aeration chamber, although there was some growth of it in the primary settling tanks.

It is difficult to attach any significance to the

findings, because no predominantly peculiar organisms were found in the Guggenheim process. Such differences as were found might have been due, at Wards Island, to the smaller amount of suspended solids; at Anderson, Indiana, to the heavy and varied industrial wastes. Euglena, in small numbers, occurred in both and it is presumed to favor iron; a few iron bacteria, Galionella, occurred at Anderson, but numbers of both these organisms were too small for significance.

1. Total species and total numbers of microscopic organisms were counted at Wards Island, activated sludge process and Guggenheim process, and at Anderson, Indiana, Guggenheim process. Particular attention was paid to the aeration chamber population.

2. The activated sludge chambers at Wards Island contained about the usual types and numbers of organisms, but two additional ones, both small holozoic flagellates, were encountered in large numbers.

3. The Guggenheim process batteries at Wards Island contained small amoebae and flagellates in numbers which in an activated sludge tank would indicate poor digestion.

4. The Guggenheim process batteries at Wards Island contained more Sphaerotilus and branching fungi than the activated sludge batteries.

5. Total numbers of organisms in the activated sludge

batteries at Wards Island were larger than in the Guggenheim process batteries.

6. Species and total numbers were least at Anderson

7. The Guggenheim process showed no dominant peculiar forms at either place.

8. Two cultures of Sphaerotilus and one of an extremely long filament forming bacillus type were isolated from Wards Island material.

TABLE I

ORGANISMS PER ML. OF MIXED LIQUOR. REPRESENTATIVE SAMPLES
WARDS ISLAND, NEW YORK AND ANDERSON, INDIANA

	Wards Island						Anderson
	Jan. 20		Jan. 20		Jan. 23		Feb. 25
	Activated Sludge		Guggenheim				Guggenheim
	A	B	C	D	C	D	
Ciliata							
Aspidisca costata	19360	1960	880	480	1120	480	
Colpidium campylum			80				
" " colpoda							67
Epistylis sp.	320		80				
Glaucoma scintillans			40				167
Lionotus fasciola	3680	440	80	80	160		33
Opercularia sp.	560						1033
Trochiliopsis opaca	320						
Vorticella sp.	5520	2960	680	40	1280	560	500
Total Ciliata	26760	5360	1840	600	2560	1040	1800
Rhizopoda							
Amoeba vespertilio	720	120					
Arcella vulgaris	640	40					
Cochliopodium bilimbosum	160						
Diplophrys archeri, large	320						
" " " " rep. cells	153600	51200	6400	1600	8000	2400	
Hartmanella hyalina	3200	16000	100800	49600	58400	52000	56000
Nuclearia simplex	2400	80	80				
Vahlkampfia albida							6800
" " gultula					800		
" " limax			1600		2400		
Total Rhizopoda	161040	67440	108880	51200	69600	54400	62800
Flagellata, except Euglenophyceae							
Bodo caudatus		30	8000	800	7200	12000	
" sp.							267
" globosus	3200	97600	153600	1600	196800	47200	
Bodopsis sp.	8000						
Cyathomonas truncata		1600					
Helkesimastix parva			1600			1600	
Monosiga ovata, colonies	320			40			
" " " single	26400	12000	800	800	4000	1600	
Monas sp.							667
Oicomonas socialis	236800	728800	76800	19200	159200	36200	
Pleuromonas jaculans		4000	1600		5600	800	133

TABLE I (Continued)

	Wards Island						Anderson
	Jan. 20		Jan. 20		Jan. 23		Feb. 25
	Activated Sludge		Guggenheim				Guggenheim
	A	B	C	D	C	D	
Peteriodendron petiolatum aggregates	160						
Peteriodendron petiolatum single	24000	3200	800	3200			
Tropomonas rotans		80	960	320	2400	800	
Unidentified small flagellates							233
Total flagellata	293880	748080	30960	23560*	171200	39220	1033
Euglenophyceae							
Astasia dangeardi					80		
Copromonas subtilis	800						
Notosolenus orbicularis	800						
Peranema trichophroum					80		
Euglena agilis?			40				33
Total Euglenophyceae	1600		40		160		33
Fungi							
Unidentified Phycomycetes				80		80	67
Zoogloea colonies	1120	800	1200	160	2400	1120	33+
Sphaerotilus colonies	nc	nc	nc	nc	nc	nc	67
" " strands					9200	1120	
Galionella							133
Green algae							
Navicula			800	800			
Chrysophyceae							
Dinobryon sertularia				400			

(*) Numbers much larger due to large aggregates of cells in colonies